Multilateral Investment Guarantee Agency

Environmental Guidelines for

Dairy Industry

Industry Description and Practices

The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese, yogurt, condensed milk, dried milk (milk power), and ice cream, using processes such as chilling, pasteurization, and homogenization. Typical by-products include buttermilk, whey, and their derivatives.

Waste Characteristics

Dairy effluents contain dissolved sugars and proteins, fats, and possible residues of additives. The key parameters are biochemical oxygen demand (BOD) (with an average ranging from 0.8 to 2.5 kilograms per metric ton (kg/t) of milk in the untreated effluent), chemical oxygen demand (COD) (normally about 1.5 times BOD level), total suspended solids (100 to 1,000 milligrams per liter (mg/L), total dissolved solids, phosphorus (10 to 100 mg/L), and nitrogen (about 6 percent of BOD level). Cream, butter, cheese, and whey production are major sources of BOD in wastewater. The waste load equivalents of specific milk constituents are: 1 kg of milk fat = 3 kg COD; 1 kg of lactose = 1.13 kg COD; and 1 kg protein = 1.36 kg COD. The wastewater may contain pathogens from contaminated materials or production processes. A dairy often generates odor and in some cases, dust, which need to be controlled. Most of the solid wastes can be processed into other products and by-products.

Pollution Prevention and Control

Good pollution prevention practices in the dairy industry include:

- Reduce product losses by better production control.
- Use disposable packaging (or bulk dispensing of milk) instead of bottles where feasible.
- Collect waste product for use in lower-grade products such as animal feed where feasible without exceeding cattle feed quality limits.
- Optimize use of water and cleaning chemicals. Recirculate cooling waters.
- Keep effluents from sanitary installations, process, and cooling (including condensation) systems segregated. This facilitates recycling of wastewater.
- Use condensates instead of fresh water for cleaning.
- Recover energy by using heat exchangers for cooling and condensing.
- Use high pressure nozzles to minimize water usage.
- Avoid the use of phosphorus-based cleaning agents.

Continuous sampling and measuring of key production parameters allow production losses to be identified and reduced, thus reducing the waste load. The following table presents product losses that are achieved in a well-run dairy:

Product Losses in the Dairy Industry

Operation	*Product losses (%)*[1]		
	Milk	Fat	Whey
Butter/transport skimmed milk	0.17	0.14	N/A
Butter + skimmed milk powder	0.60	0.20	N/A
Cheese	0.20	0.10	1.6
Cheese + whey evaporation	0.20	0.10	2.2
Cheese + whey powder	0.20	0.10	2.3
Consumer milk	1.9	0.7	N/A
Full cream milk powder	0.64	0.22	N/A

[1] Expressed as percentage of volume of milk, fat or whey processed.
N/A = Not Applicable.

Odor problems can usually be prevented with good hygiene and storage practices. Chlorinated fluorocarbons should not be used in the refrigeration system.

Target Pollution Loads

Since the pollutants generated by the industry are very largely losses in production, improvements in production efficiency (as detailed in the previous section) are recommended to reduce pollutant loads.

Wastewater loads are typically 1-2 cubic meters per metric ton (m^3/t) of milk processed, and the plant operators should aim to achieve rates of 1 m^3/t or less at intake of effluent treatment system. BO level should be less than 2.5 kg/t of milk with an aim to achieve 1-1.5 kg/t. BOD level from butter and cheese production should be less than 2 kg/t of product.

Treatment Technologies

Pretreatment of effluents comprises of screening, flow equalization, neutralization, and air flotation (to remove fats and solids); it is normally followed by biological treatment. If space is available, land treatment or pond systems are potential treatment methods. Other possible biological treatment systems include trickling filters, rotating biological contactors, and activated sludge treatment.

Pretreated dairy effluents can be discharged to a municipal sewerage system, if capacity exists, with the approval of the relevant authority.

Odor control by ventilation and scrubbing may be required where cheese is stored or melted. Dust control at milk powder plants is provided by fabric filters.

Emission Guidelines

Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and the *Pollution Prevention and Abatement Handbook* as applied to local conditions. The emission levels selected must be justified in the EA and acceptable to MIGA.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance, including MIGA guarantees; any deviations from these levels must be described in the project documentation.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Air Emissions

Odor controls (such as absorbents/biofilter on exhaust systems) should be implemented where necessary to achieve acceptable odor quality for nearby residents. Fabric filters should be used to control dust to below 50 milligrams per normal cubic meter (mg/Nm^3) from milk powder production.

Liquid Effluents

The following effluent levels should be achieved:

Effluents from the Dairy Industry

Parameter	*Maximum value milligrams per liter (mg/L)*
pH	6 – 9
BOD_5	50
COD	250
Total suspended solids	50
Oil and grease	10
Total nitrogen	10
Total Phosphorus	2
Temperature increase	less than or equal to 3^0C[1]
Coliform bacteria	400 Most Probable Number/100 ml

[1] The effluent should result in a temperature increase of no more than 3 degrees Celsius at the edge of the zone where initial mixing and dilution takes place. Where the zone is not defined, use 100 meters from the point of discharge.

Note: Effluent requirements are for direct discharge to surface waters.

Ambient Noise

Noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Ambient Noise

	Maximum Allowable L_{eq} (hourly), in dB(A)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The emission requirements given here can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems.

Monitoring and Reporting

Monitoring of the final effluent for the parameters listed above should be carried out at least once per month, or more frequently if the flows vary significantly.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required, and provided to MIGA if requested.

Key Issues

The following box summarizes the key production and control practices that will lead to compliance with emission guidelines:

- Monitor key production parameters to reduce product losses.
- Use disposable packaging (or bulk dispensing of milk) instead of bottles where feasible.
- Design and operate the production system to achieve recommended wastewater loads.
- Recirculate cooling waters.
- Collect wastes for use in low-grade products.

Further Information

The following are suggested as sources of additional information (these sources are provided for guidance and are not intended to be comprehensive):

Economopoulos, A.P. 1993. "Rapid Inventory Techniques in Environmental Pollution." In *Assessment of Sources of Air, Water and Land Pollution*. Geneva: World Health Organization.

Robinson, R.K. 1986. “Advances in Milk Products.” In *Modern Dairy Technology*, Vol. 2. Amsterdam: Elseviers Applied Science Publishers.

World Bank, Environment Department. 1996. "Pollution Prevention and Abatement: Dairy Industry." Technical Background Document.